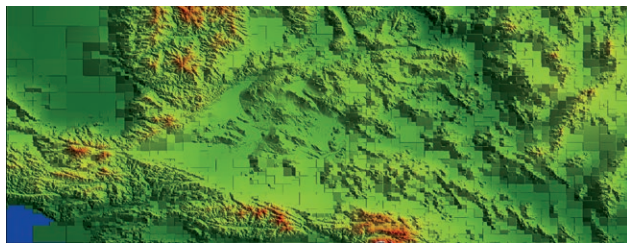
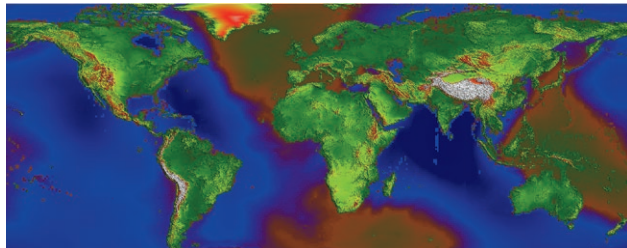
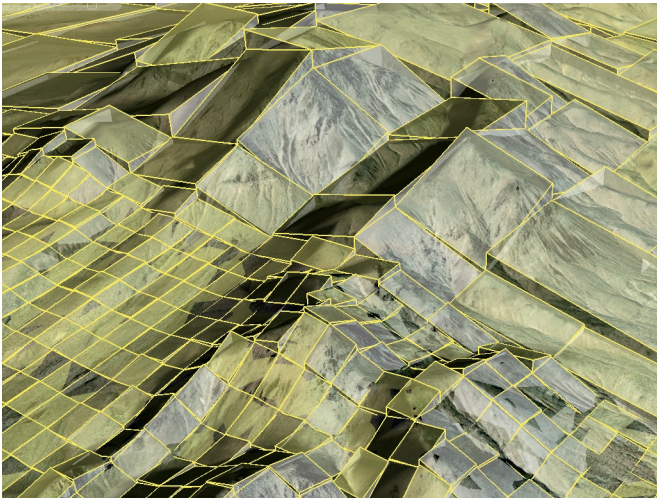




## technology opportunity

# Real-Time, High-Resolution Terrain Information in Computing-Constrained Environments

*Software for aeronautics collision avoidance, satellite, automotive, and research applications*



*Terrain maps generated by the Global Elevation Data Adaptive Compression System. (NASA images)*

Data adaptive algorithms are the critically enabling technology for automatic collision avoidance system efforts at NASA's Armstrong Flight Research Center. These Armstrong-developed algorithms provide an extensive and highly efficient encoding process for global-scale digital terrain maps (DTMs) along with a real-time decoding process to locally render map data. Available for licensing, these terrain-mapping algorithms are designed to be easily integrated into an aircraft's existing onboard computing environment or into an electronic flight bag (EFB) or mobile device application. In addition to its use within next-generation collision avoidance systems, the software can be adapted for use in a wide variety of applications, including aerospace satellites, automobiles, scientific research, marine charting systems, and medical devices.

[www.nasa.gov](http://www.nasa.gov)

## Benefits

- **Efficient:** Provides very high encoding process ratios and rapid, high-performance down sampling in ultrafast, real-time, constrained-computing environments
- **Powerful:** Integrates >250 billion pieces of terrain information into a single digital terrain map
- **Improved imaging:** Images with 1,000 times more detail and 2 to 3 times more fidelity than current aircraft mapping systems
- **Highly configurable:** Merges DTM products to create the best global DTM at any desired resolution with easily defined geo-referenced variable fidelity that requires a minimum file size
- **Accurate:** Features spatially controlled allowable-error induction in several independent regions
- **Portable:** Works on mobile devices and with EFBs
- **Affordable and accessible:** Compatible with existing aircraft systems, offering industry standard C, C++ code base and map formats

## Applications

Useful in applications that require high-resolution terrain data but have few computing resources:

- Military and civil aeronautics (collision avoidance, aerial firefighting, crop dusting)
- Unmanned aerial vehicle (UAV) navigation and research
- Automotive global positioning systems (GPS)
- Geographical predication and planning (wind turbines, watershed, weather, urban planning)
- Marine charting systems
- Geospatial information systems
- Medical software
- Earth science data collection
- Gaming systems

## Licensing and Partnering Opportunities

This technology is part of NASA's technology transfer program, which seeks to transfer technology into and out of NASA to benefit the space program and U.S. industry. NASA invites companies to consider licensing the Global Elevation Data Adaptive Compression Algorithms (DRC-009-008) for further development and commercial applications.

## Technology Details

NASA Armstrong collaborated with the U.S. Air Force to develop algorithms that interpret highly encoded large area terrain maps with geographically user-defined error tolerances. A key feature of the software is its ability to locally decode and render DTMs in real time for a high-performance airplane that may need automatic course correction due to unexpected and dynamic events. Military jets often encounter such conditions flying into and out of extreme locations. NASA Armstrong researchers are integrating the algorithms into a Global Elevation Data Adaptive Compression System (GEDACS) software package, which will enable users to create customized maps from a variety of data sources using a single, easy-to-use graphical user interface.

### How It Works

The DTM software achieves its high performance encoding and decoding processes using a unique combination of regular and semi-regular geometric tiling for optimal rendering of a requested map. This geometric tiling allows the software to retain important slope information and continuously and accurately represent the terrain. Maps and decoding logic are integrated into an aircraft's existing onboard computing environment and can operate on a mobile device application, an EFB, or flight control and avionics computer systems. Users can adjust the DTM encoding routines and error tolerances to suit evolving platform and mission requirements. Maps can be tailored to support flight profiles of a wide range of aircraft, including fighter jets, UAVs, and general aviation aircraft.

The DTM and GEDACS software fit into the overall scheme of next-generation ground collision avoidance technology by enabling the encoding of global digital terrain data into a file size small enough to fit onto a tablet or other handheld/mobile device. By using improved digital terrain data, an aircraft could attain better performance. The system monitors the ground approach and an aircraft's ability to maneuver to avoid it by predicting

several multidirectional escape trajectories, a feature that will be particularly advantageous to general aviation aircraft.

### Why It Is Better

Conventional DTM encoding techniques used aboard high-performance aircraft typically achieve relatively low encoding process ratios. Also, the computational complexity of the decoding process can be high, making them unsuitable for the real-time constrained computing environments of high-performance aircraft. In addition, implementation costs are generally prohibitive for general aviation aircraft.

The Armstrong-developed software achieves its high encoding process ratio by intelligently interpreting its maps rather than requiring absolute retention of all data. For example, the DTM software notes the perimeter and depth of a mining pit but ignores contours that are irrelevant based on the climb and turn performance of a particular aircraft and therefore does not waste valuable computational resources. Through this type of intelligent processing, the software eliminates the need to maintain absolute retention of all data and achieves a much higher encoding process ratio than conventional terrain-mapping software. The resulting exceptional encoding process allows users to store a much larger library of DTMs in one place, enabling comprehensive map coverage at all times.

Additionally, the ability to selectively tailor resolution enables high-fidelity sections of terrain data to be incorporated seamlessly into a map.

## Patent

NASA has applied for patent protection for this technology.

**For more information about this technology, please contact:**

**NASA's Armstrong Flight Research Center**

**Phone: (661) 276-5743**

**E-mail: [dfrc-tto@mail.nasa.gov](mailto:dfrc-tto@mail.nasa.gov)**

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